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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Applicant:

Daniel Xu et al.

Serial No.: 09/976,641

Filed: October 12, 2001

For: Reducing Leakage Currents in
Memories With Phase-Change
Material

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Art Unit: 2815

Examiner: Bradley W. Baumeister

Atty Docket: ITO.0504US
P12497

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REPLY BRIEF

Sir:

The Examiner's Answer makes a great number of assertions (which Appellants dispute) about what the Appellants have admitted and not admitted. Rather than spend too much time trying to address what has and has not been admitted, the Reply Brief will attempt to focus on what is missing from the prior art and the rejection. Namely, the elements claimed are nowhere shown in any of the references, even if they were combinable, and the references are not properly combinable.

To attempt to simplify things, we can try to use the Examiner's nomenclature. Without admitting that this is commensurate with the scope of the claim, we can simply adopt the Examiner's shorthand expression that the claims would cover a structure he calls an n/n+/n/p

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structure in a bulk substrate. In other words, there are three regions of the same conductivity type with a more heavily doped region in the middle and more lightly doped regions on the edge and a region of the opposite conductivity type near one of the more lightly doped regions of the first conductivity type. As a shorthand expression this will be referred to as the “four layer structure.”

The Examiner contends that Ovshinsky teaches what the Examiner would apparently contend is an $n^+/n/p$ structure. This is hard to discern, but, as best it can be determined, this is the Examiner’s contention. This is based on his statement, on page 4 near the end of paragraph a., that Ovshinsky does not teach “the presence of a lightly doped n-type region interposed between the n^+ region and the p-type substrate.” Thus, he apparently contends, and (for now it may not matter if he is right or not), that Ovshinsky teaches an $n^+/n/p$ structure.

Then, the Examiner moves to Chang and apparently contends that Chang teaches an $n/n^+/p$ structure. What is remarkable is that neither reference teaches the combination of four layers in the claimed orientation. Instead, the Examiner suggests that one simply add the two references together somehow.

However, to do so, the Examiner must ignore the absence of any asserted rationale from within the prior art to do so. Why would two inventors, which each only teach three layers, suddenly decide that four layers are better? What would lead them to create a four layer structure when they each only proposed three layers? The assertion that they teach doing so to reduce leakage is illogical because each of the references had three layers and presumably believed that he admirably reduced leakage. Thus, there was no suggestion to reduce leakage by providing the four layer structure in either reference or their combination.

The asserted rationales to combine are inapposite. The suggestion that making the four layered structure is conventional or well known or anything else is far too little, too late. The Examiner never suggested that such a thing was well known during prosecution and to do so now is improper and is respectfully disputed. Instead, this contention at this late date is simply a tacit admission that there is no suitable rationale from within the references themselves that teaches any reason to depart from their teachings of three layer (not four layer) structures.

Moreover, assertions that the differences are “not significant,” “minor,” and “obvious from a physics-concept point of view” simply demonstrate the weakness of the Examiner’s argument. None of these arguments are statutorily appropriate. They simply highlight the fact that there is no objective basis derivable from the prior art to make the claimed invention.

Subjective conclusions have no place in the obviousness analysis. The obviousness analysis requires an objective review. The objective standard requires the citation of art, not tossing out subjective or conclusory assertions.

Finally, the Examiner attempts to put the shoe on the other foot. He suggests that it is the Appellants who have failed to fulfill their burden of demonstrating the non-obviousness of the claimed invention. However, this is improper too. The statutory requirement is that the Examiner first provide a *prima facie* rejection. Assertions based on subjective reasoning without support within the art fail to raise to the standard which needs to be traversed by the Appellants.

Nonetheless, the Appellants have gone beyond what is required and demonstrated non-obviousness (though they need not have done so in the absence of a *prima facie* rejection). The problem that is pointed out previously is how to make the n/n+/n/p structure. If one attempts to make a first implant to make a p-region from top down to a depth x, for example, one could next attempt to do an n-type implant which converts the entire structure down to a depth y, which is

less than x . Then one is left to attempt to try to form an n^+ region in the middle of that n -type area of depth y . It is not so obvious how or why to do so and there is nothing in any of the references that suggests how or why to do so. The cited references did not address this problem because they were creating three layer structures, not four layer structures.

Thus, the problem presented is that the fabrication technique to create the structure raises a problem which never had to be addressed by either of the cited three layer references. Therefore, those three layer references are deficient, *inter alia*, because they do not teach how to make the four layer structure with the claimed arrangement. Moreover, they are deficient because they do not teach a reason to make a four layer structure. Finally, they are deficient because they do not teach the four layers in the arrangement claimed.

And even if the references were combined, they simply combine to teach variations of three layer structures. They provide no rationale whatsoever to depart from the three layer structure and attempt to overcome the problem of how to make a four layer structure to solve a problem which they never recognized in their three layer structures (which they presumably thought were just fine).

The Examiner also seems to argue that somehow Slotboom can be thrown into the mix and helps to substantiate the obviousness of the claimed four layer structure. The Examiner suggests that Slotboom teaches a $p^+/p/n$ or an $n^+/n/p$ structure. How this helps is certainly unclear to the Appellants. It is but yet another attempted combination of one more three layer structure. How or why the Examiner believes that it teaches a four layer structure, suggests how to make the four layer structure, or suggests how to overcome the problem of making the four layer structure with the arrangement claimed is never explained.

An example of the asserted rationales to combine which are based on nothing in any of the cited references is the following:

It would have been obvious to one of ordinary skill in the art at the time of the invention to have further included additional, more lightly doped n-type regions between the n+ channel and p-substrate of the Ovshinsky memory device for the purpose of reducing current leakage as taught by Chang.

Answer, page 5. But, of course, Chang taught a three layer structure just like Ovshinsky. It makes no sense that Chang somehow teaches departing from the three layer conventional approach to make a four layer structure to solve the leakage problem with three layer structures which neither Ovshinsky or Chang ever appreciated.

Another asserted rationale is the following:

It would have been obvious to one of ordinary skill in the art at the time of the invention to have formed all of the pn diode's bulk and epi regions as taught by Ovshinsky/Chang solely in a bulk substrate without growing an epilayer, as taught by Chang for the purpose of simplifying the manufacturing process and thereby reducing the associated manufacturing costs.

Answer, page 5, at paragraph C. There is nothing in Chang or Ovshinsky that suggests that forming their structures entirely within the substrate, instead of partially within the substrate and partially thereover, would save costs. To the contrary, it is believed that Ovshinsky and Chang would have never knowingly done anything that would have unnecessarily increased costs. Nothing is ever cited in either of these references to suggest that forming a structure entirely within the substrate would have reduced costs. Plainly, this is a statutorily impermissible concoction based on hindsight reasoning.

On page 9, the Examiner suggests that "the prior art reasonably teaches or suggests that this conventional modification, was, in fact, possible." Since the prior art never even recognized

the possibility of a four layer structure, it is not seen how such a structure can be termed conventional nor how it can be suggested that the prior art taught that it was possible. Moreover, even if the prior art recognized that structures were possible, this would not amount to a teaching in the prior art.

Further down on page 9, it is asserted that “the stated motivation to combine was for the purpose of reducing current leakage into the substrate. This motivation -- which is the same reason Appellant employs this lowermost n-type region -- was taught by Chang (e.g., column 4, lines 10-).” But to the extent Chang taught that his three layer structure reduced leakage, he teaches away from producing a four layer structure. If Chang and Ovshinsky teach that three layer structures reduce leakage, then why would one bother with a four layer structure? What would lead one of skill in the art to attempt to make a four layer structure when, according to the Examiner, Chang teaches that a three layer structure reduces leakage?

At the top of page 10, the Examiner suggests that the Appellants have not adequately contested whether or not a skilled artisan would have desired to add this further n-type region under the wordline. Certainly this is not the Appellants’ burden. The Appellants’ position is simply to state that there is no teaching in any of the cited art which teaches any rationale to do so or any structure to do so. It is impossible to devine what one skilled in the art might or might not have desired at some time in the past. Moreover, such an inquiry is totally irrelevant.

Next, further down on page 10, the Examiner contends that “it would have been further obvious to have alternatively formed all four of the layers solely in the bulk-silicon substrate because this was a conventional, functionally equivalent way of forming dope layers on the surface of a Si substrate.” The problem is that if the Examiner made some objective showing that this was conventional, then perhaps he would have an argument. His problem here is that he

has not made out a *prima facie* case. He simply has made the unsupported conclusion that this is conventional. But by citing a number of references, all of which use three layer structures not four, he has simply made the point for Appellants. It cannot be conventional and the Examiner cannot suggest the same when he cannot show a four layer structure in the bulk substrate.

The Examiner contends that both of these two “conventional, functionally equivalent” alternatives had well known associated advantages and disadvantages. However, the asserted advantages and disadvantages are nowhere cited in the prior art, but, instead, are self-serving concoctions made up by the Examiner. Again, the Examiner focuses on a subjective personal analysis and fails to provide the objective support for his positions. Try as he might, he simply cannot twist the references, which do not teach four layers in the substrate, to make them teach four layers in the substrate. He can attempt to address, after the fact, hindsight induced advantages and disadvantages without support in the prior art, but these efforts, no matter how extensive, still do not create a *prima facie* rejection.

The suggestion that the claimed structure and the three layer structure are functionally equivalent is both perplexing and irrelevant. The issue is not whether they are functionally equivalent. They are plainly not functionally equivalent as the Examiner has pointed out throughout his Answer. He repeatedly suggests that everyone skilled in the art would have appreciated the advantages of the four layer structure. He cannot, on one hand, say that the advantages of the four layer structure are obvious and, on the other hand, suggest that the three layer structures and the four layer structures are functionally equivalent.

Finally, the Appellants’ specification is asserted to indicate that different ion implantation techniques could be utilized to make the claimed invention and it is argued that this somehow supports the contention that the claimed invention is obvious. The fact that there are different

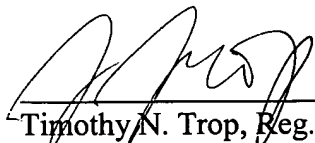
ways to do what is claimed is almost always the case. The assertion that the Appellants have somehow admitted that nothing can be patentable because there may be a variety of ways to form the claimed structure is simply nonsense. Every claimed invention, hopefully, has lots of ways to form the structure. The Appellants should not be limited to the precise way that is set forth in the specification. To argue that the assertion that there are different ways to meet the claimed invention is tantamount to an admission that the claimed invention is obvious would doom substantially every single patentable invention.

Because the prior art fails to teach a four layer structure in a bulk substrate or any reason to modify the three layer structures to make the four layer structure, the claimed invention is not obvious and a *prima facie* rejection is not made out.

Moreover, even if a *prima facie* rejection were made out, the Appellant has established non-obviousness by showing that a different fabrication technique would be needed to make the four layers in the arrangement claimed in the substrate than would be needed for a three layer design. While it is respectfully submitted that, in the absence of a *prima facie* case, no such showing was necessary, it only further augments the non-obviousness conclusion which should be drawn in this case.

Respectfully submitted,

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